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Guenther et al.

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(54) **METHODS, APPARATUSES AND COMPUTER PROGRAM PRODUCT FOR USER EQUIPMENT AUTHORIZATION BASED ON MATCHING NETWORK ACCESS TECHNOLOGY SPECIFIC IDENTIFICATION INFORMATION**

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H04W 4/00 (2009.01)
H04L 29/06 (2006.01)
(Continued)

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CPC ***H04L 63/08*** (2013.01); ***H04L 29/12188*** (2013.01); ***H04L 61/1588*** (2013.01); ***H04W 12/06*** (2013.01); *H04L 65/1016* (2013.01); *H04W 80/10* (2013.01); *H04W 84/12* (2013.01)

(58) **Field of Classification Search**
CPC H04L 65/1016; H04L 63/08; H04L 12/14; H04L 61/1588; H04W 12/06; H04W 60/00; H04W 60/04; H04W 8/26; H04W 8/04; H04W 4/00
USPC 455/435.1, 433, 411, 416, 432.1, 404.1, 455/410; 370/352, 338, 329, 230, 401, 328; 380/270; 709/225
See application file for complete search history.

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(Continued)

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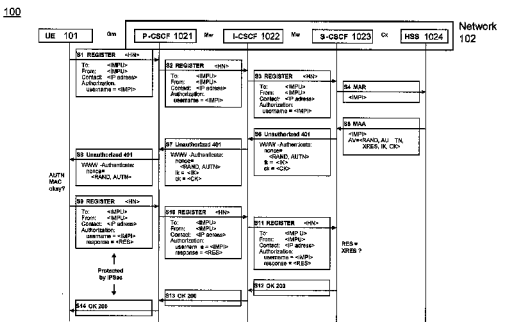
(57) **ABSTRACT**

It is disclosed a method including providing a relation of network access technology-specific identification information (NATSII) of a user equipment or user and network identity-related information (NIRI) of the user equipment, receiving an inquiry comprising network identity-related inquiry information (NIRII), resolving the received NIRII based on the provided relation, and sending a response including the NATSII according to a result of the resolved NIRII; a method including receiving a registration request comprising NIRII from a user equipment or user, obtaining NATSII based on the received NIRII, appending the received NIRII with the obtained NATSII, and sending the appended NIRII; and a method including receiving a registration request comprising first NATSII and NIRI, obtaining second NATSII based on the received NIRI, matching the received first NATSII against the obtained second NATSII, and authorizing access for a user equipment based on a result of matching.

27 Claims, 7 Drawing Sheets



(51) **Int. Cl.**

H04L 29/12	(2006.01)
H04W 12/06	(2009.01)
H04W 80/10	(2009.01)
H04W 84/12	(2009.01)

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3GPP TR 33.978 V6.6.0 (Dec. 2006) Technical Report 3rd Generation Partnership Project Technical Specification Group Services and System Aspects; Security aspects of early IP Multimedia Subsystem (IMS) (Release 6).

* cited by examiner

Fig. 1

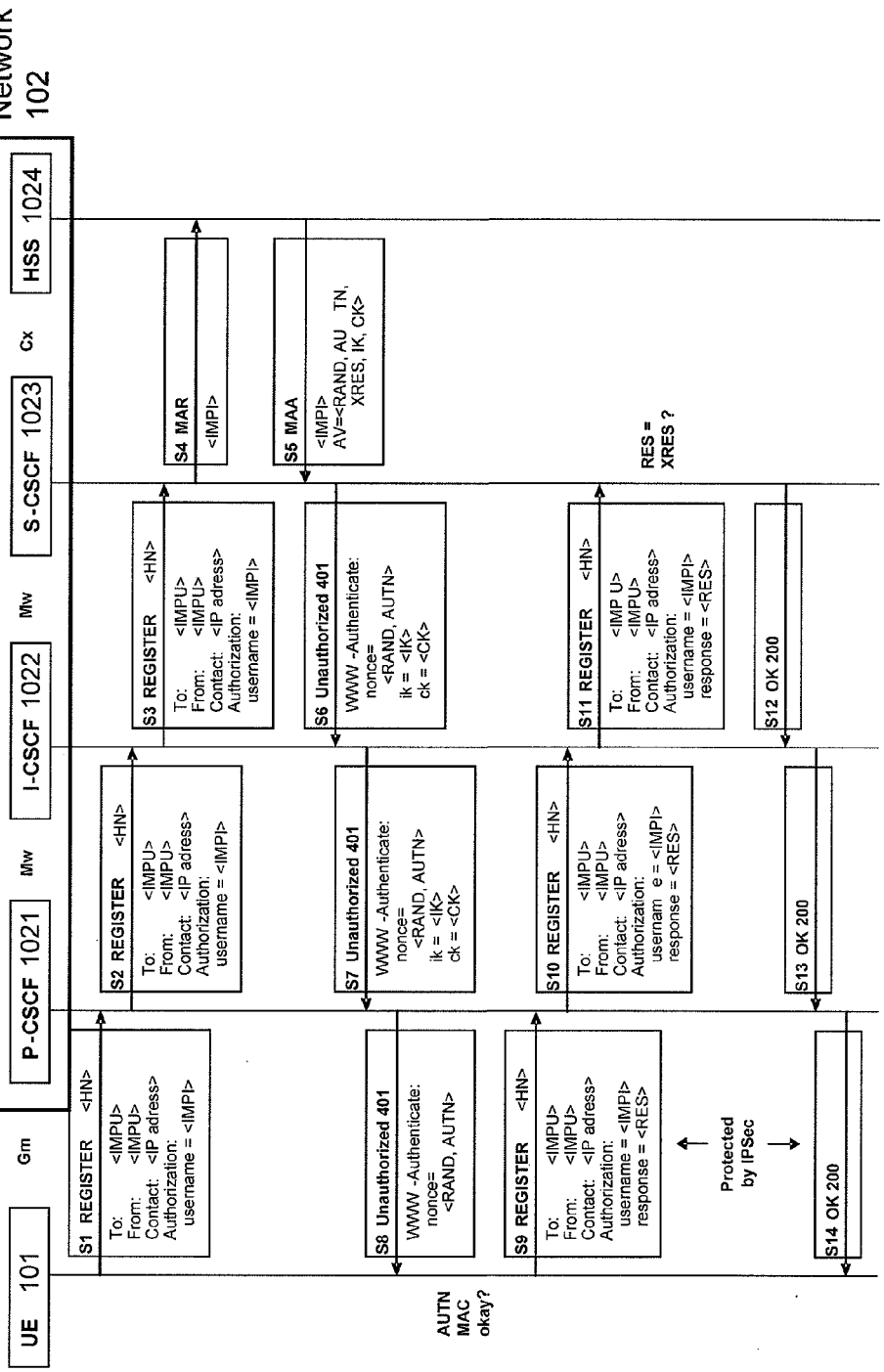

100
UE 101
Gm
P-CSCF 1021
Mw
I-CSCF 1022
Mw
S-CSCF 1023
Cx
HSS 1024
Network 102
S1 REGISTER <HN>
To: <IMPU>
From: <IMPU>
Contact: <IP adress>
Authorization:
username = <IMPI>
S2 REGISTER <HN>
To: <IMPU>
From: <IMPU>
Contact: <IP adress>
Authorization:
username = <IMPI>
S3 REGISTER <HN>
To: <IMPU>
From: <IMPU>
Contact: <IP adress>
Authorization:
username = <IMPI>
S4 MAR
<IMPI>
S5 MAA
<IMPI>
AV=<RAND, AU TN, XRES, IK, CK>
S6 Unauthorized 401
WWW -Authenticate:
nonce=
<RAND, AUTN>
ik = <IK>
ck = <CK>
S7 Unauthorized 401
WWW -Authenticate:
nonce=
<RAND, AUTN>
ik = <IK>
ck = <CK>
S8 Unauthorized 401
WWW -Authenticate:
nonce=
<RAND, AUTN>
AUTN MAC okay?
S9 REGISTER <HN>
To: <IMPU>
From: <IMPU>
Contact: <IP adress>
Authorization:
username = <IMPI>
response = <RES>
S10 REGISTER <HN>
To: <IMPU>
From: <IMPU>
Contact: <IP adress>
Authorization:
usernam e = <IMPI>
response = <RES>
RES = XRES ?
S11 REGISTER <HN>
To: <IMP U>
From: <IMPU>
Contact: <IP adress>
Authorization:
username = <IMPI>
response = <RES>
S12 OK 200
S13 OK 200
S14 OK 200
Protected by IPSec

Fig. 2

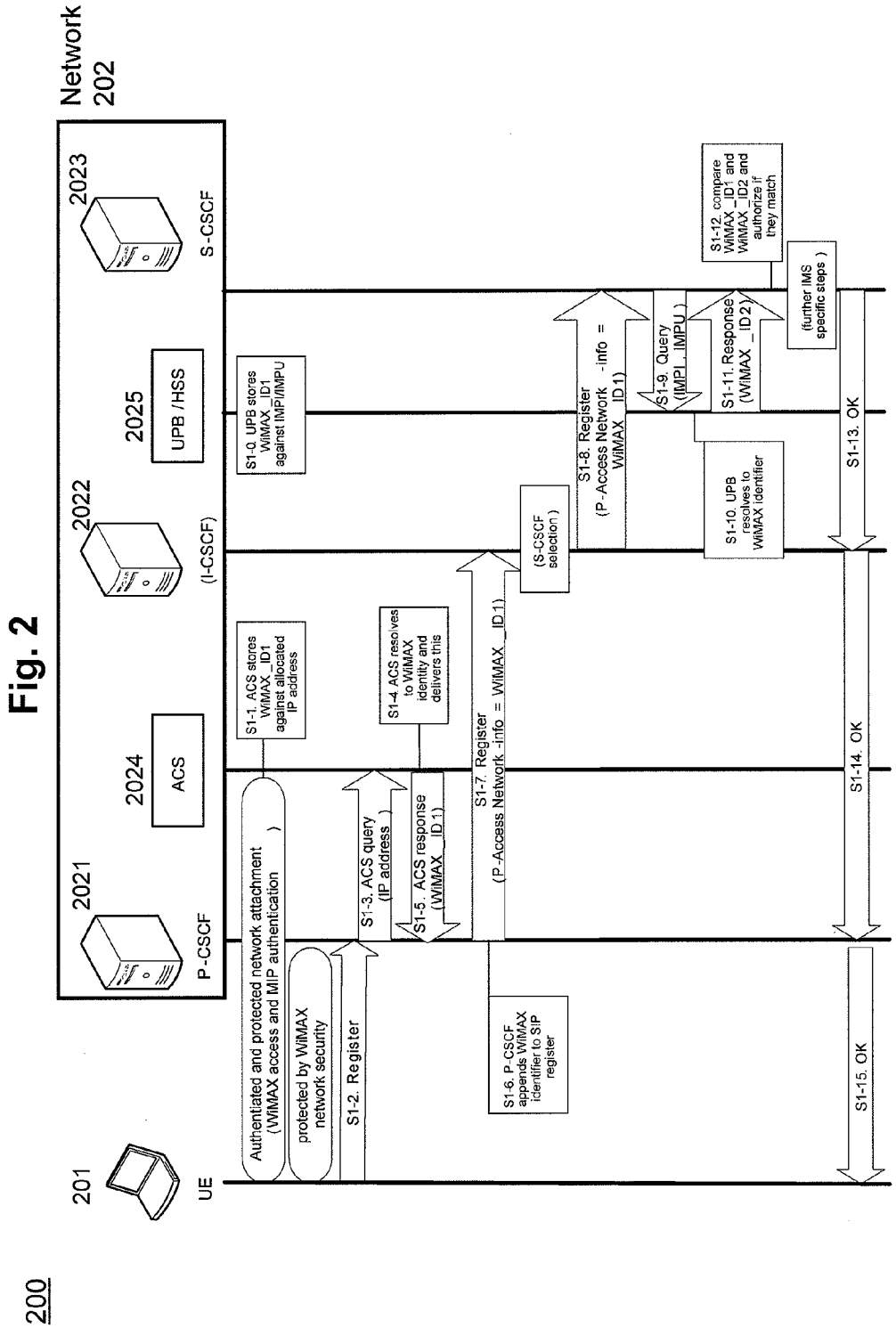

200
Network 202
2021
P-CSCF
2024
ACS
2022
(I-CSCF)
2025
UPB /HSS
2023
S-CSCF
201
UE
Authentiated and protected network attachment (WiMAX access and MIP authentication)
protected by WiMAX network security
S1-1. ACS stores WiMAX_ID1 against allocated IP address
S1-2. Register
S1-3. ACS query (IP address)
S1-4 ACS resolves to WiMAX identity and delivers this
S1-5. ACS response (WiMAX_ID1)
S1-6. P-CSCF appends WiMAX identifier to SIP register
S1-7. Register (P-Access Network -info = WiMAX_ID1)
(S-CSCF selection)
S1-8. Register (P-Access Network -info = WiMAX_ID1)
S1-9. Query (IMPI, IMPU)
S1-10. UPB resolves to WiMAX identifier
S1-11. Response (WiMAX_ID2)
S1-12. compare WiMAX_ID1 and WiMAX_ID2 and authorize if they match
(further IMS specific steps)
S1-13. OK
S1-14. OK
S1-15. OK
S1-0. UPB stores WiMAX_ID1 against IMPI/IMPU

Fig. 3

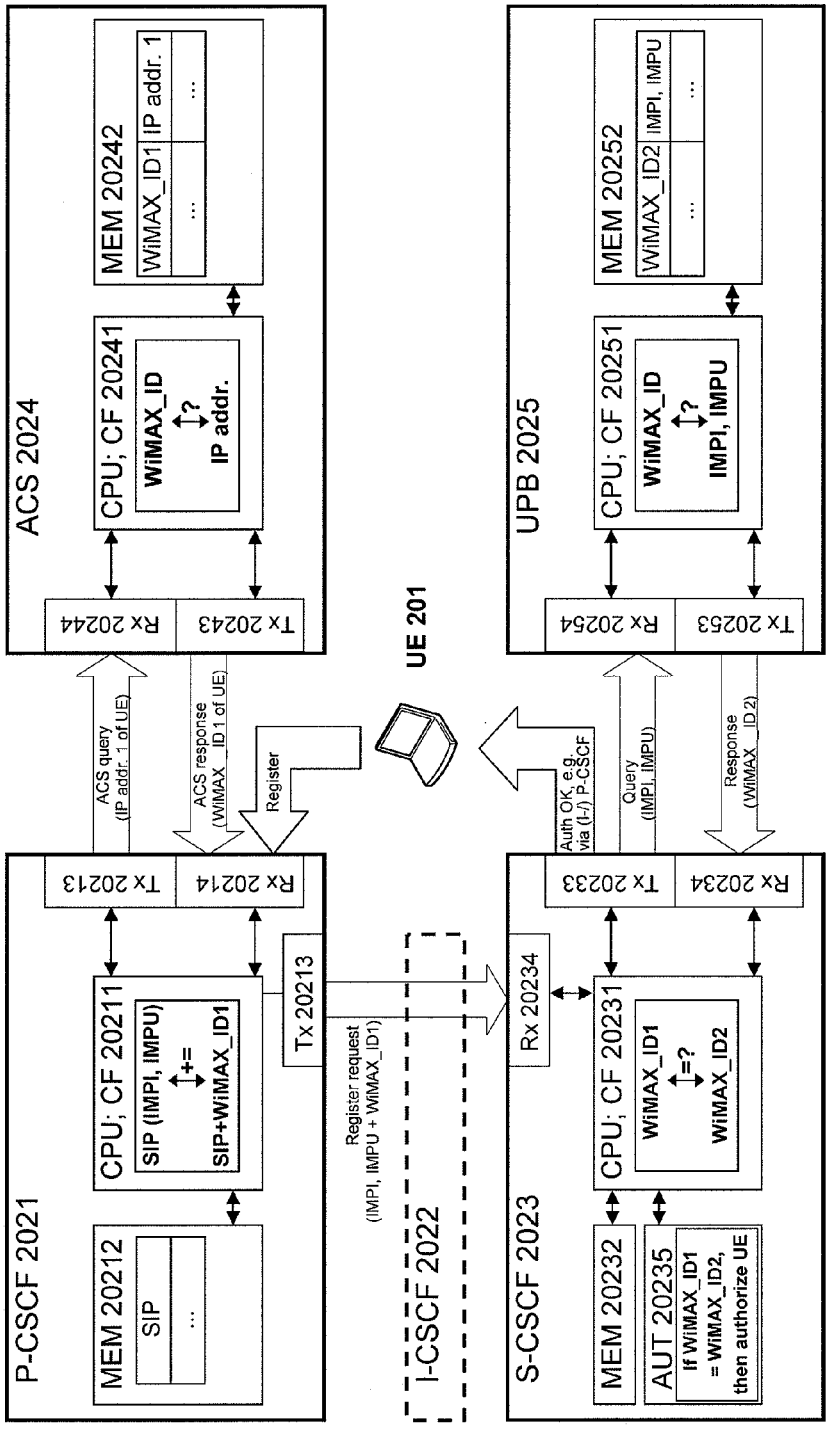

ACS 2024
MEM 20242
WiMAX_ID1
IP addr. 1
CPU; CF 20241
WiMAX_ID
IP addr.
Tx 20243
Rx 20244
UPB 2025
MEM 20252
WiMAX_ID2
IMPI, IMPU
CPU; CF 20251
WiMAX_ID
IMPI, IMPU
Tx 20253
Rx 20254
UE 201
ACS query (IP addr. 1 of UE)
ACS response (WiMAX_ID 1 of UE)
Register
Auth OK, e.g. via (I-/) P-CSCF
Query (IMPI, IMPU)
Response (WiMAX_ID 2)
P-CSCF 2021
MEM 20212
SIP
CPU; CF 20211
SIP (IMPI, IMPU)
+=
SIP+WiMAX_ID1
Tx 20213
Rx 20214
Register request (IMPI, IMPU + WiMAX_ID1)
I-CSCF 2022
S-CSCF 2023
MEM 20232
AUT 20235
If WiMAX_ID1 = WiMAX_ID2, then authorize UE
CPU; CF 20231
WiMAX_ID1
=?
WiMAX_ID2
Rx 20234
Tx 20233
Rx 20234

Fig. 4

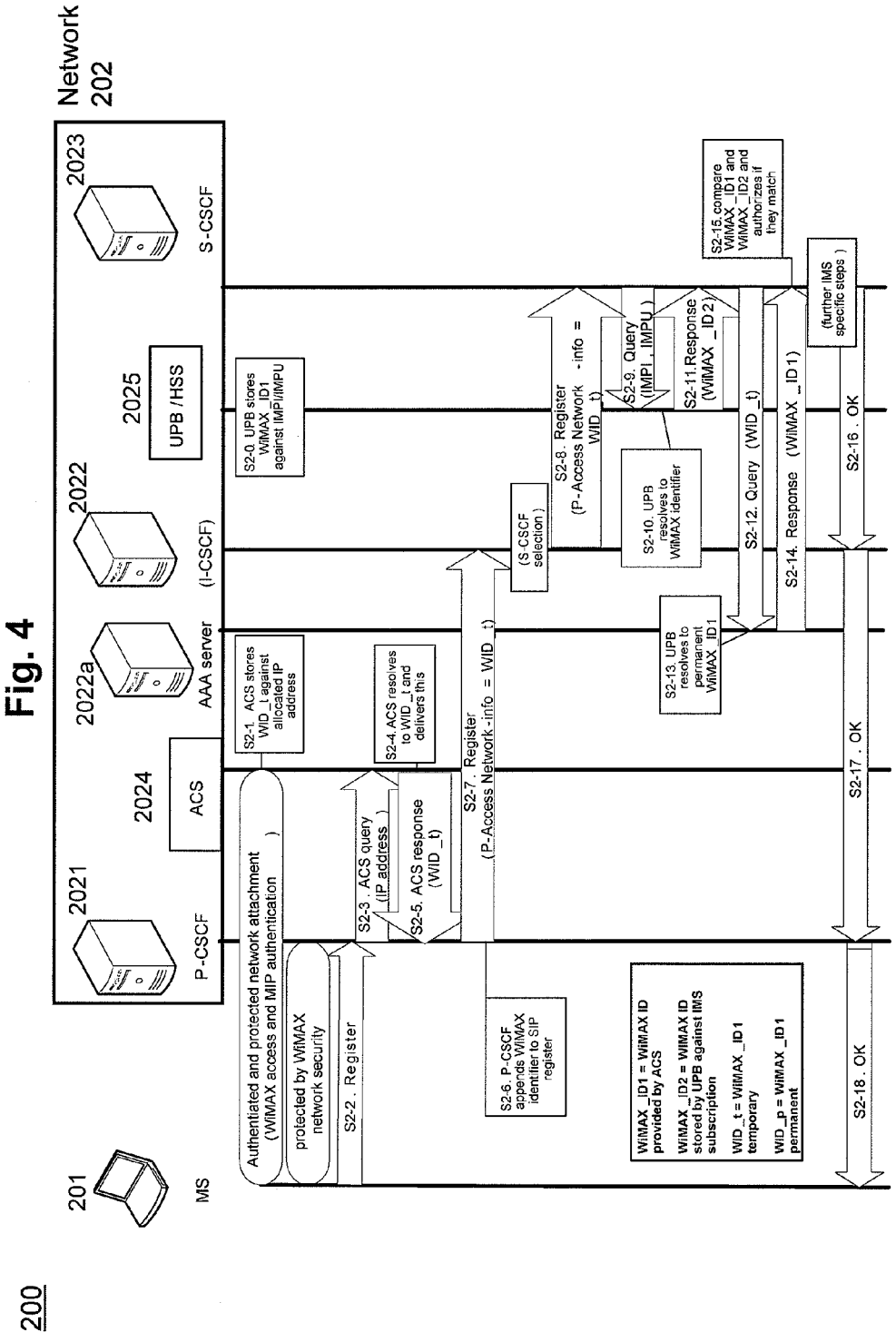

200
Network 202
MS
201
P-CSCF
2021
ACS
2024
AAA server
2022a
(I-CSCF)
2022
UPB /HSS
2025
S-CSCF
2023
Authentiated and protected network attachment (WiMAX access and MIP authentication)
protected by WiMAX network security
S2-1. ACS stores WID_t against allocated IP address
S2-2. Register
S2-3. ACS query (IP address)
S2-4. ACS resolves to WID_t and delivers this
S2-5. ACS response (WID_t)
S2-6. P-CSCF appends WiMAX identifier to SIP register
S2-7. Register (P-Access Network-info = WID_t)
S2-0. UPB stores WiMAX_ID1 against IMPI/IMPU
(S-CSCF selection)
S2-8. Register (P-Access Network - info = WID_t)
S2-9. Query (IMPI , IMPU)
S2-10. UPB resolves to WiMAX identifier
S2-11.Response (WiMAX _ID2)
S2-12. Query (WID_t)
S2-13. UPB resolves to permanent WiMAX_ID1
S2-14. Response (WiMAX _ID1)
S2-15.compare WiMAX_ID1 and WiMAX_ID2 and authorizes if they match
S2-16 . OK
(further IMS specific steps)
S2-17 . OK
S2-18 . OK
WiMAX_ID1 = WiMAX ID provided by ACS
WiMAX_ID2 = WiMAX ID stored by UPB against IMS subscription
WID_t = WiMAX_ID1 temporary
WID_p = WiMAX_ID1 permanent

Fig. 5

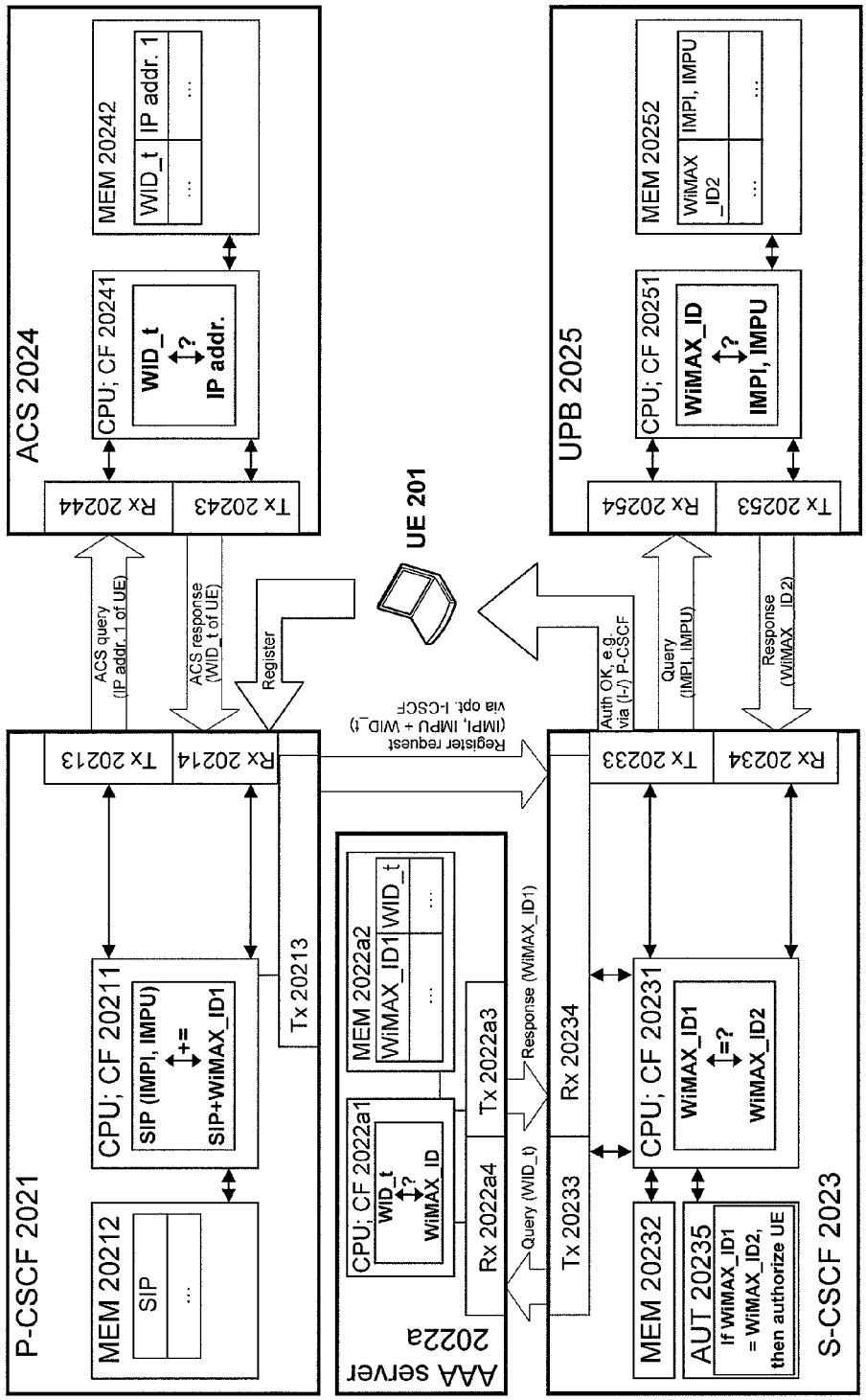

ACS 2024
MEM 20242
WID_t
IP addr. 1
CPU; CF 20241
WID_t
IP addr.
Tx 20243
Rx 20244
UPB 2025
MEM 20252
WiMAX_ID2
IMPI, IMPU
CPU; CF 20251
WiMAX_ID
IMPI, IMPU
Tx 20253
Rx 20254
UE 201
ACS query (IP addr. 1 of UE)
ACS response (WID_t of UE)
Register
Register request (IMPI, IMPU + WID_t) via opt. I-CSCF
Auth OK, e.g. via (I-/) P-CSCF
Query (IMPI, IMPU)
Response (WiMAX_ID2)
P-CSCF 2021
MEM 20212
SIP
CPU; CF 20211
SIP (IMPI, IMPU)
SIP+WiMAX_ID1
Tx 20213
Rx 20214
AAA server 2022a
MEM 2022a2
WiMAX_ID1
WID_t
CPU; CF 2022a1
WID_t
WiMAX_ID
Tx 2022a3
Rx 2022a4
Response (WiMAX_ID1)
Query (WID_t)
S-CSCF 2023
MEM 20232
AUT 20235
If WiMAX_ID1 = WiMAX_ID2, then authorize UE
CPU; CF 20231
WiMAX_ID1
WiMAX_ID2
Tx 20233
Rx 20234

Fig. 6

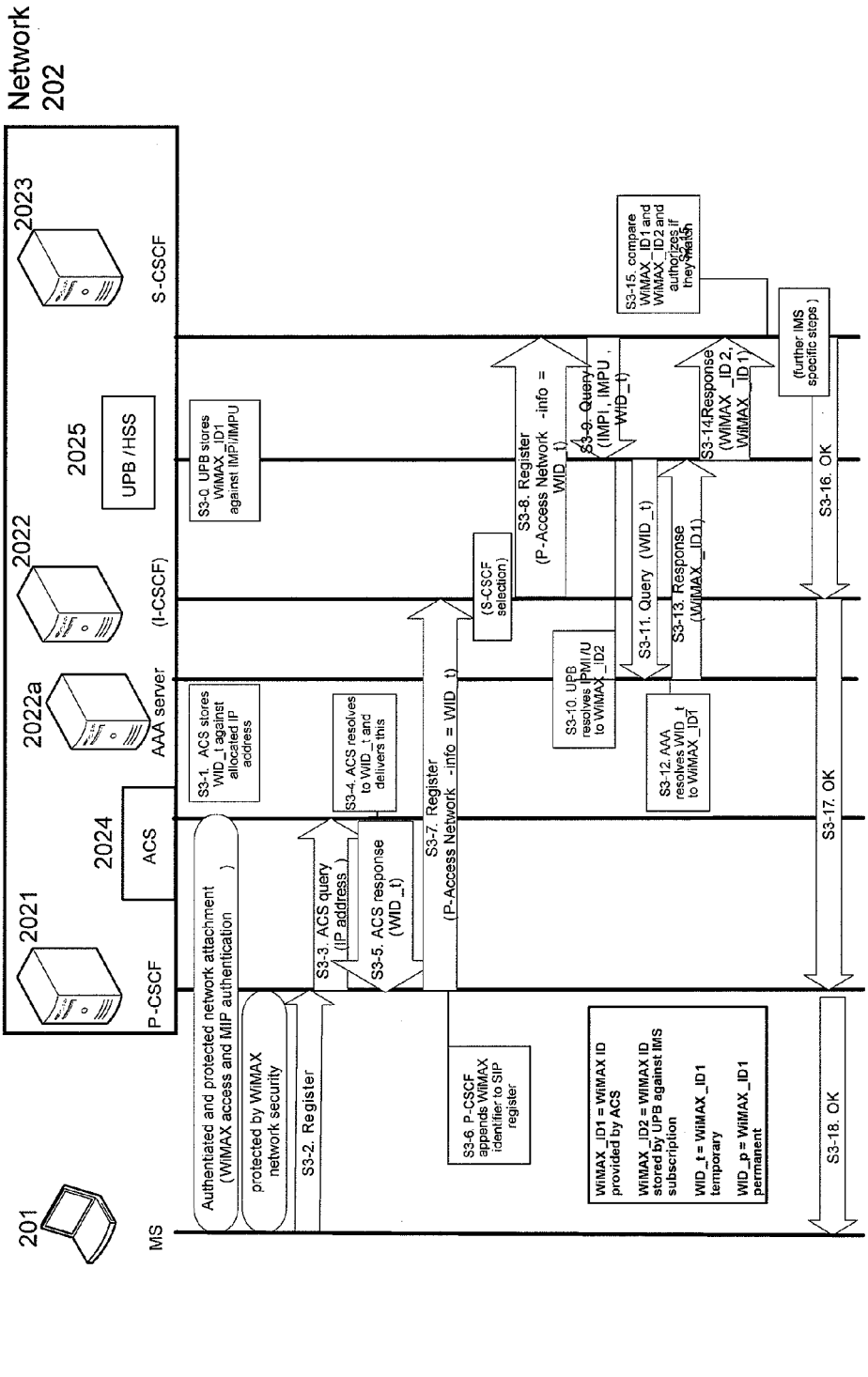
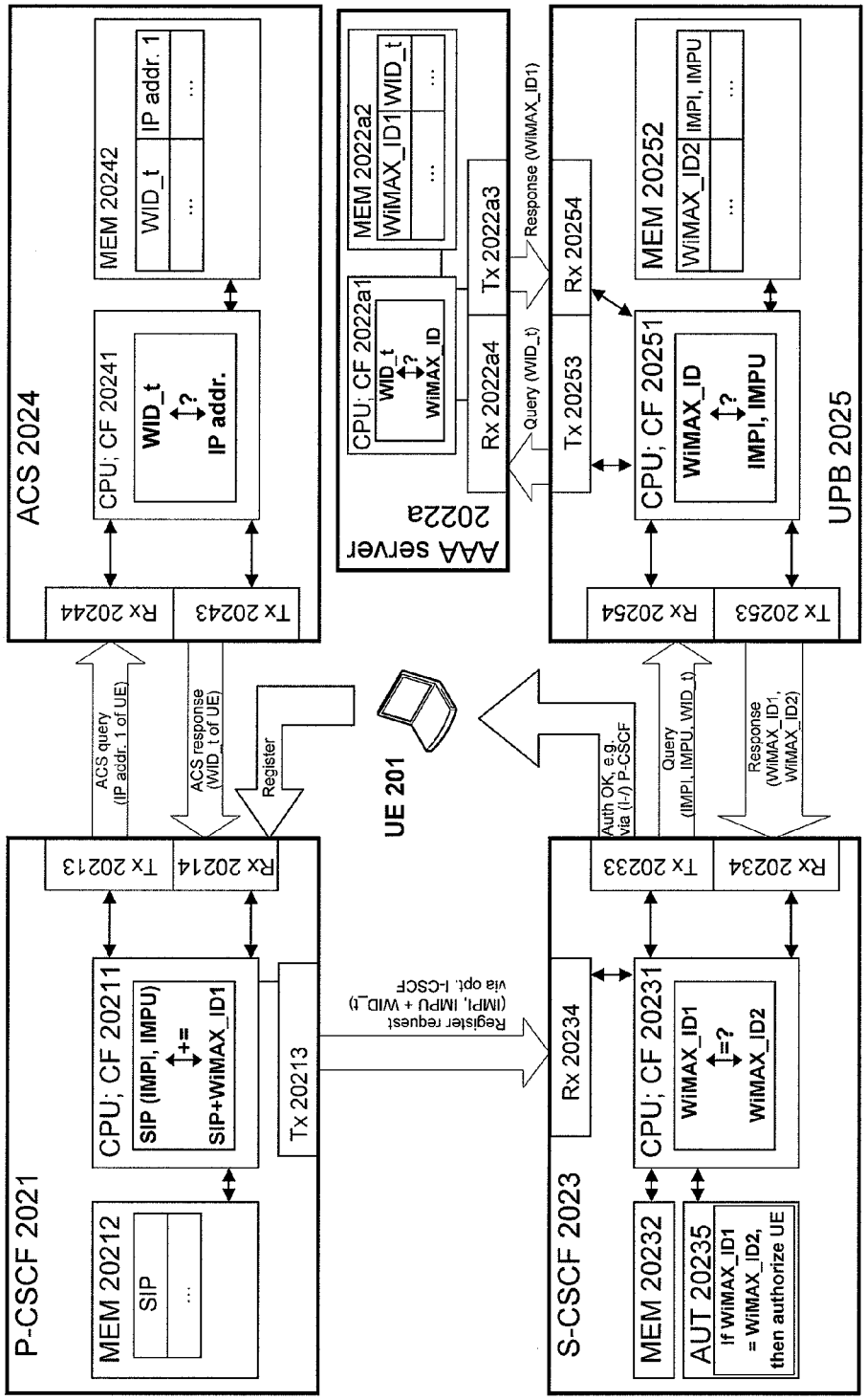

200
Network 202
201
MS
2021
P-CSCF
2024
ACS
2022a
AAA server
2022
(I-CSCF)
2025
UPB /HSS
2023
S-CSCF
Authentiated and protected network attachment (WiMAX access and MIP authentication)
protected by WiMAX network security
S3-1. ACS stores WID_t against allocated IP address
S3-2. Register
S3-3. ACS query (IP address)
S3-4. ACS resolves to WID_t and delivers this
S3-5. ACS response (WID_t)
S3-6. P-CSCF appends WiMAX identifier to SIP register
S3-7. Register (P-Access Network -info = WID_t)
S3-0. UPB stores WiMAX_ID1 against IMPI/IMPU
(S-CSCF selection)
S3-8. Register (P-Access Network -info = WID_t)
S3-9. Query (IMPI, IMPU, WID_t)
S3-10. UPB resolves IMPI/U to WiMAX_ID2
S3-11. Query (WID_t)
S3-12. AAA resolves WID_t to WiMAX_ID1
S3-13. Response (WiMAX_ID1)
S3-14.Response (WiMAX_ID 2, WiMAX_ID 1)
S3-15. compare WiMAX_ID1 and WiMAX_ID2 and authorizes if they match
(further IMS specific steps)
S3-16. OK
S3-17. OK
S3-18. OK
WiMAX_ID1 = WiMAX ID provided by ACS
WiMAX_ID2 = WiMAX ID stored by UPB against IMS subscription
WID_t = WiMAX_ID1 temporary
WID_p = WiMAX_ID1 permanent

Fig. 7


ACS 2024
MEM 20242
WID_t
IP addr. 1
CPU; CF 20241
WID_t
IP addr.
Rx 20244
Tx 20243
AAA server 2022a
MEM 2022a2
WiMAX_ID1
WID_t
CPU; CF 2022a1
WID_t
WiMAX_ID
Rx 2022a4
Tx 2022a3
Query (WID_t)
Response (WiMAX_ID1)
UPB 2025
MEM 20252
WiMAX_ID2
IMPI, IMPU
CPU; CF 20251
WiMAX_ID
IMPI, IMPU
Rx 20254
Tx 20253
Rx 20254
Tx 20253
ACS query (IP addr. 1 of UE)
ACS response (WID_t of UE)
Register
UE 201
Auth OK, e.g. via (i-/) P-CSCF
Query (IMPI, IMPU, WID_t)
Response (WiMAX_ID1, WiMAX_ID2)
P-CSCF 2021
MEM 20212
SIP
CPU; CF 20211
SIP (IMPI, IMPU)
+=
SIP+WiMAX_ID1
Rx 20214
Tx 20213
Tx 20213
Register request (IMPI, IMPU + WID_t) via opt. I-CSCF
S-CSCF 2023
MEM 20232
AUT 20235
If WiMAX_ID1 = WiMAX_ID2, then authorize UE
CPU; CF 20231
WiMAX_ID1
=?
WiMAX_ID2
Rx 20234
Tx 20233
Rx 20234
Tx 20233

METHODS, APPARATUSES AND COMPUTER PROGRAM PRODUCT FOR USER EQUIPMENT AUTHORIZATION BASED ON MATCHING NETWORK ACCESS TECHNOLOGY SPECIFIC IDENTIFICATION INFORMATION

FIELD OF THE INVENTION

The present invention relates to UE (user equipment) or user authorization e.g. in WiMAX (Worldwide Interoperability for Microwave Access) networks and the interworking with IMS (IP (Internet Protocol) Multimedia Subsystem) networks. More specifically, the present invention relates to methods, apparatuses, a system and a related computer program product by means of which e.g. user equipment such as WiMAX mobile stations (WiMAX terminal devices on the user side) or WiMAX stationary terminal devices may be authorized to access e.g. IMS services over a WiMAX network.

BACKGROUND

In 3GPP (3^{rd} Generation Partnership Project) and the WiMAX Forum, there have been discussions related to user equipment authorization.

Namely, WiMAX networks have been specified by the WiMAX Forum Networking Group (NWG). These WiMAX networks provide e.g. broadband IP connectivity to mobile stations via an air interface as defined e.g. by the IEEE (Institute of Electrical and Electronics Engineers) 802.16e-2005 standard. The IMS is a multi-media architecture for both mobile and fixed-line IP services. Originally, the IMS has been defined by 3GPP, and was largely adopted e.g. by 3GPP2 (Third Generation Partnership Project 2) or by ETSI (European Telecommunications Standards Institute) TISPAN (Telecoms and Internet Converged Services and Protocols for Advanced Network).

For example, FIG. **1** shows a method for access authorization to IMS services as specified e.g. by 3GPP TS (Technical Specification) 33.203. The methods defined by TS 33.203 are based on the requirement that a UICC (Universal Integrated Circuit Card) is inserted into the UE. Generally put, an ISIM (IMS Services Identity Module, an application running on the UICC) and the IMS HN (Home Network) of the ISIM authenticate each other based on a long-term key being secretly shared by both ISIM and HN.

As shown in FIG. **1**, a communication system **100** comprises a UE **101** and a network **102**. The network **102** in turn comprises a P-CSCF (Proxy Call Session Control Function) **1021**, an I-CSCF (Interrogating CSCF) **1022**, an S-CSCF (Serving CSCF) **1023** and a HSS (Home Subscriber Server) **1024**. Signalling between elements is indicated in horizontal direction, while time aspects between signalling are reflected in the vertical arrangement of the signalling sequence as well as in the sequence numbers.

The message flow as shown in FIG. **1** depicts the IMS access authorization procedure as defined e.g. by TS 33.203. This procedure is commonly referred to as IMS-AKA (Authentication and Key Agreement).

In step **S1**, a SIP (Session Initiation Protocol) REGISTER request is sent from the UE **101** to the P-CSCF **1021**. This request contains the domain name <HN> of the Home Network as read from the ISIM of the UE **101**, the subscriber's private and public IMS identities <IMPI> and <IMPU>, as well as the IP address (obtained prior to IMS AKA) of the UE **101**. Besides the IP address, all these data are read from the ISIM.

In step **S2**, the SIP REGISTER request is sent from the P-CSCF **1021** to the I-CSCF **1022**. The P-CSCF **1021** resolves the address of the I-CSCF **1022** in the HN and forwards the identities IMPI, IMPU and the IP address received in step **S1** to the I-CSCF **1022** of the HN.

In step **S3**, the SIP REGISTER request is sent from the I-CSCF **1022** to the S-CSCF **1023**. The I-CSCF **1022** in turn forwards these identities IMPI, IMPU and the IP address to the S-CSCF **1023** serving this request.

In step **S4**, a MAR (Multimedia Access Request) is sent from the S-CSCF **1023** to the HSS **1024**. In this MAR, the S-CSCF **1023** requests authentication data from the HSS with respect to the IMS subscriber identified by <IMPI>.

In step **S5**, a MAA (Multimedia Access Answer) is sent from the HSS **1024** to the S-CSCF **1023**. The HSS **1024** sends an Authentication Vector (AV) to the S-CSCF **1023** containing the following types of data: random challenge RAND, expected answer XRES, network authentication token AUTN that contains a message integrity code MAC, integrity key IK, and ciphering key CK.

In step **S6**, a SIP Unauthorized **401** message is sent from the S-CSCF **1023** to the I-CSCF **1022**. At this point in time, the S-CSCF **1023** denies the UE authentication. Instead, the S-CSCF **1023** sends the SIP Unauthorized message with a WWW-Authenticate header to the I-CSCF **1022**. This header contains RAND, AUTN, IK and CK. The value XRES, however, is held back by the S-CSCF **1023**.

In step **S7**, a SIP Unauthorized **401** message is sent from the I-CSCF **1022** to the P-CSCF **1021**. The I-CSCF **1022** forwards RAND, AUTN, IK and CK to the P-CSCF **1021** as received in the previous step **S6**.

In step **S8**, a SIP Unauthorized **401** message is sent from the P-CSCF **1021** to the UE **101**. The P-CSCF **1021** sends RAND and AUTN to the UE **101**, i.e., the P-CSCF **1021** does not forward IK and CK to the UE **101**, but stores IK and CK for later use.

In step **S9**, a SIP REGISTER request is sent from the UE **101** to the P-CSCF **1021**. The ISIM of the UE **101** computes the value RES by means of input of its version of the secret key K. Then, the UE **101** sends a new SIP REGISTER request to the P-CSCF **1021**, this time alongside with RES as response to the challenge initiated by the S-CSCF **1023** in step **S6**. This SIP REGISTER request is protected by IPSec (Internet Protocol Security) (integrity protection mandatory, encryption depends on UE **101** and P-CSCF **1021** capabilities and P-CSCF **1021** policy). To this end, the UE **101** has calculated the keys IK and CK on input of RAND and the secret key K.

In step **S10**, a SIP REGISTER request is sent from the P-CSCF **1021** to the I-CSCF **1022**. The P-CSCF **1021** forwards RES to the I-CSCF **1022**.

In step **S11**, a SIP REGISTER request is sent from the I-CSCF **1022** to the S-CSCF **1023**. The I-CSCF **1022** forwards RES to the S-CSCF **1023**.

In step **S12**, in case of success, a SIP message OK **200** is sent from the S-CSCF **1023** to the I-CSCF **1022**. That is, in case RES equals XRES, the S-CSCF **1023** considers the subscriber (i.e. the UE **101**) authenticated, and binds <IMPU> to the IP address <IP address>. The S-CSCF **1023** informs the I-CSCF **1022** about this decision.

In step **S13**, a SIP message OK **200** is sent from the I-CSCF **1022** to the P-CSCF **1021**. That is, the I-CSCF **1022** forwards the SIP message OK **200** to the P-CSCF **1021**.

Finally, in step S14, a SIP message OK **200** is sent from the P-CSCF **1021** to the UE **101**. That is, the P-CSCF **1021** forwards the SIP message OK **200** to the UE **101**. This message is also protected by means of IPSec.

As an alternative, TS 33.203 also defines a slight variant of IMS-AKA that is suitable for UICCs without an ISIM, but in that case, an USIM (UMTS (Universal Mobile Telecommunications System) Subscriber Identity Module) application is running on the UICC of the UE **101**. However, also in that variant, a UICC must be present in the UE **101**.

According to the above, a problem is related to the issue of how to authorize WiMAX Mobile Stations to access IMS services without mandating a UICC to be inserted into the MS/UE.

In consideration of the above, it is an object of the present invention to overcome one or more of the above drawbacks. In particular, the present invention provides methods, apparatuses, a system and a related computer program product for user equipment or user authorization.

According to the present invention, in a first aspect, this object is for example achieved by a method comprising:

providing a relation of network access technology-specific identification information of a user equipment or user and network identity-related information of the user equipment;

receiving an inquiry comprising network identity-related inquiry information;

resolving the received network identity-related inquiry information based on the provided relation; and

sending a response comprising the network access technology-specific identification information according to a result of the resolved network identity-related inquiry information.

According to further refinements of the invention as defined under the above first aspect,

the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol address allocated to the user equipment;

the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

According to the present invention, in a second aspect, this object is for example achieved by a method comprising:

receiving a registration request comprising network identity-related inquiry information from a user equipment or user;

obtaining network access technology-specific identification information based on the received network identity-related inquiry information;

appending the received network identity-related inquiry information with the obtained network access technology-specific identification information; and

sending the appended network identity-related inquiry information.

According to the present invention, in a third aspect, this object is for example achieved by a method comprising:

receiving a registration request comprising first network access technology-specific identification information and network identity-related information;

obtaining second network access technology-specific identification information based on the received network identity-related information;

matching the received first network access technology-specific identification information against the obtained second network access technology-specific identification information; and

authorizing access for a user equipment based on a result of matching.

According to further refinements of the invention as defined under the above third aspect,

the received network identity-related information comprises an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

According to further refinements of the invention as defined under the above first to third aspects,

the network access-technology-specific identification information comprises an identifier specific for worldwide interoperability for microwave access;

the network access-technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session;

in the receiving, the received first network access technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, and the method further comprises

obtaining, as the first network access technology-specific identification information, an actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session;

in the receiving, the received first network access technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session,

wherein the obtaining is based on the received network identity-related information and the received first network access technology-specific identification information, and obtains, as the first network access-technology-specific identification information, a first actual identifier specific for worldwide interoperability for microwave access, and obtains, as the second network access-technology-specific identification information, a second actual identifier specific for worldwide interoperability for microwave access;

in the receiving, the received inquiry comprises both network identity-related information and one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session,

wherein the method further comprises obtaining, from another network element, a first actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session,

wherein, in the resolving, the received network identity-related information is resolved based on the provided relation to provide a second actual identifier specific for worldwide interoperability for microwave access, and

wherein, in the sending, the response comprises both the first obtained actual identifier specific for worldwide interoperability for microwave access and the resolved second actual identifier specific for worldwide interoperability for microwave access;

the network access technology-related identification information comprises at least one of a network access identifier, a security parameter index value, and an access, authorization and accounting server identification;

the network identity-related information comprises a mobile internet protocol home address;

the network identity-related information is a internet protocol address used by the user equipment, the internet protocol address being ensured to be constituted by the internet protocol address correspondingly allocated by a network to the user equipment.

According to the present invention, in a fourth aspect, this object is for example achieved by an apparatus comprising:

means for providing a relation of network access technology-specific identification information of a user equipment or user and network identity-related information of the user equipment;

means for receiving an inquiry comprising network identity-related inquiry information;

means for resolving the received network identity-related inquiry information based on the provided relation; and

means for sending a response comprising the network access technology-specific identification information according to a result of the resolved network identity-related inquiry information.

According to further refinements of the invention as defined under the above fourth aspect,

the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol address allocated to the user equipment;

the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

According to the present invention, in a fifth aspect, this object is for example achieved by an apparatus comprising:

means for receiving a registration request comprising network identity-related inquiry information from a user equipment or user;

means for obtaining network access technology-specific identification information based on the received network identity-related inquiry information;

means for appending the received network identity-related inquiry information with the obtained network access technology-specific identification information; and

means for sending the appended network identity-related inquiry information.

According to the present invention, in a sixth aspect, this object is for example achieved by an apparatus comprising:

means for receiving a registration request comprising first network access technology-specific identification information and network identity-related information;

means for obtaining second network access technology-specific identification information based on the received network identity-related information;

means for matching the received first network access technology-specific identification information against the obtained second network access technology-specific identification information; and

means for authorizing access for a user equipment based on a result of matching.

According to further refinements of the invention as defined under the above sixth aspect,

the received network identity-related information comprises an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

According to further refinements of the invention as defined under the above fourth to sixth aspects,

the network access-technology-specific identification information comprises an identifier specific for worldwide interoperability for microwave access;

the network access-technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session;

the means for receiving is configured to receive the first network access technology-specific identification information comprising one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, and

the means for obtaining is configured to obtain, as the first network access technology-specific identification information, an actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session;

the means for receiving is configured to receive the first network access technology-specific identification information comprising one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, and

the means for obtaining is configured to obtain, based on the received network identity-related information and the received first network access technology-specific identification information, and to obtain, as the first network access-technology-specific identification information, a first actual identifier specific for worldwide interoperability for microwave access, and to obtain, as the second network access-technology-specific identification information, a second actual identifier specific for worldwide interoperability for microwave access;

the means for receiving is configured to receive the inquiry comprises both network identity-related information and one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session,

the means for obtaining is configured to obtain, from another network element, a first actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session,

the means for resolving is configured to resolve the received network identity-related information based on the provided relation to provide a second actual identifier specific for worldwide interoperability for microwave access, and

the means for sending is configured to send the response comprising both the first obtained actual identifier specific for worldwide interoperability for microwave access and the resolved second actual identifier specific for worldwide interoperability for microwave access;

the network access technology-related identification information comprises at least one of a network access identifier, a security parameter index value, and an access, authorization and accounting server identification;

the network identity-related information comprises a mobile internet protocol home address;

the network identity-related information is a internet protocol address used by the user equipment, the internet protocol address being ensured to be constituted by the internet protocol address correspondingly allocated by a network to the user equipment;

the apparatus according to the first aspect is a user profile binding entity being a portion of one of a home sub-

scriber server and an access, authorization and accounting server or interfacing with at least one of the home subscriber server and the access, authorization and accounting server;

the apparatus according to the first aspect is an access control support entity being a portion of or interfacing with one of a mobile internet protocol home agent and an internet protocol router;

the apparatus is implemented as a chipset or module.

According to the present invention, in a seventh aspect, this object is for example achieved by a system comprising:

a user equipment;

apparatuses according to the above fourth aspect;

an apparatus according to the above fifth aspect; and

an apparatus according to the above sixth aspect.

According to the present invention, in an eighth aspect, this object is for example achieved by a computer program product comprising code means for performing methods steps of a method according to any one of the above first to third aspects, when run on a computer.

In this connection, it has to be pointed out that the present invention enables one or more of the following:

UICC-free IMS access authorization for WiMAX mobile stations/user equipments.

Reducing costs for operators and customers to consume IMS services.

A low-cost network based security solution for IMS that is able to support any IMS capable user device and that offers an appropriate security level.

Possibility of parallel usage with any other security mechanisms securing IMS access e.g. through WiMAX to provide an additional security step, resulting in a more secure overall system.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention are described herein below with reference to the accompanying drawings, in which:

FIG. **1** shows a method for user equipment authorization as specified by e.g. by 3GPP TS 33.203;

FIG. **2** shows respective methods for user equipment authorization according to a first embodiment of the present invention;

FIG. **3** shows respective apparatuses (e.g. ACS (Access Control Support), UPB (User Profile Binding), P-CSCF and S-CSCF functions) for user equipment authorization according to the first embodiment of the present invention;

FIG. **4** shows respective methods for user equipment authorization according to a second embodiment of the present invention;

FIG. **5** shows respective apparatuses (e.g. ACS (Access Control Support), UPB (User Profile Binding), P-CSCF and S-CSCF functions) for user equipment authorization according to the second embodiment of the present invention;

FIG. **6** shows respective methods for user equipment authorization according to a modification of the second embodiment of the present invention; and

FIG. **7** shows respective apparatuses (e.g. ACS, UPB, P-CSCF and S-CSCF functions) for user equipment authorization according to the modification of the second embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE PRESENT INVENTION

Embodiments of the present invention are described herein below by way of example with reference to the accompanying drawings.

The embodiments may be summarized according to the following: The present invention is related to introduce e.g. an IMS access authorization method that does not require the presence of a UICC in the WiMAX Mobile Station, but reuses the WiMAX network access authorization methods and features inherently implemented in WiMAX Mobile Stations and networks for the purpose of granting access to IMS services.

It is to be noted that for this description, the terms "WiMAX_ID (identifier specific for WiMAX, e.g. a NAI (Network Access Identifier), see below), WID_t (identifier specific for a WiMAX subscription or session, see below)" and "IMPI/IMPU, IP address" are examples for "network access technology-specific identification information" and "network identity-related information", respectively, without restricting the latter terms to the special technical or implementation details imposed to the terms "WiMAX_ID, WID_t" and "IMPI/IMPU, IP address".

[First Embodiment]

As shown in FIG. **2**, a communication system **200** may comprise a UE **201** and a network **202**. The network **202** in turn may comprise a P-CSCF **2021**, an optional I-CSCF **2022**, a S-CSCF **2023**, an ACS function **2024** and a UBP function **2025** (e.g. in a HSS (Home Subscriber Server)) **1024**. Signalling between elements is indicated in horizontal direction, while time aspects between signalling are reflected in the vertical arrangement of the signalling sequence as well as in the sequence numbers.

As a preparatory measure, in step **S1-0**, a relation of network access technology-specific identification information (e.g. WiMAX_ID**1**, such as NAI) of a user equipment (e.g. UE **201**) and network identity-related information (e.g. IP address) of the user equipment or user may be stored and provided by the ACS **2024**. In addition, a relation of network access technology-specific identification information (e.g. WiMAX_ID**2**, such as NAI) of a user equipment (e.g. UE **201**) and network identity-related information (e.g. IMPI, IMPU) of the user equipment or user may be stored and provided by the UPB **2025**.

In step **S1-2**, e.g. the P-CSCF **2021** may perform receiving a registration request (e.g. Register) comprising network identity-related inquiry information (e.g. the IP address and SIP information) from a user equipment (e.g. UE **201**).

In steps **S1-3** and **S1-5**, e.g. the P-CSCF **2021** may perform obtaining, e.g. from the ACS **2024**, network access technology-specific identification information (e.g. WiMAX specific identifier WiMAX_ID**1**) based on the received network identity-related inquiry information.

In addition, concerning steps **S1-3** to **S1-5**, in step **1-3**, e.g. the ACS **2024** may perform receiving (e.g. from the P-CSCF **2021**) the inquiry comprising the network identity-related inquiry information (e.g. IP address of the UE **201**).

In step **S1-4**, e.g. the ACS **2024** may perform resolving the received network identity-related inquiry information (e.g. IP address of the UE **201**) based on the provided relation (stored and provided in step **S1-1** as described hereinabove).

And, in step **S1-5**, e.g. the ACS **2024** may perform sending a response (e.g. to the P-CSCF **2021**) comprising the network access technology-specific identification information (e.g. WiMAX_ID**1**) according to a result of the resolved network identity-related inquiry information (e.g. IP address of the UE **201**).

In step **S1-6**, e.g. the P-CSCF **2021** may perform appending the received network identity-related inquiry information (e.g. SIP information) with the obtained network access technology-specific identification information (e.g. WiMAX specific identifier WiMAX_ID**1**).

And, in step **S1-7**, e.g. the P-CSCF may perform sending the appended network identity-related inquiry information (e.g. SPI (IMPI, IMPU) and WiMAX_ID**1**).

It is to be noted that the appended network address inquiry information may be sent directly to the S-CSCF **2023**, or alternatively, via the optional I-CSCF **2022**.

In step **S1-8**, e.g. the S-CSCF **2023** may perform receiving (e.g. from the P-CSCF **2021**) a registration request comprising first network access technology-specific identification information (e.g. WiMAX_ID**1**) and network identity-related information (e.g. IMPI, IMPU).

In steps **S1-9** and **S1-11**, e.g. the S-CSCF **2023** may perform obtaining (e.g. from the UPB **2025**) second network access technology-specific identification information (e.g. WiMAX specific identifier WiMAX_ID**2**) based on the received network identity-related information (e.g. IMPI, IMPU).

Concerning steps **S1-9** to **S1-11**, in step **S1-9**, e.g. the UPB **2025** may perform receiving (e.g. from the S-CSCF **2023**) an inquiry comprising network identity-related inquiry information (e.g. IMPI, IMPU).

In step **S1-10**, e.g. the UPB **2025** may perform resolving the received network identity-related inquiry information (e.g. IMPI, IMPU) based on the provided relation (stored and provided in step **S1-0** as described hereinabove).

And, in step **S1-11**, e.g. the UPB **2025** may perform sending (e.g. to the S-CSCF **2023**) a response comprising the network access technology-specific identification information (e.g. WiMAX_ID**2**) according to a result of the resolved network identity-related inquiry information (e.g. IMPI, IMPU).

Furthermore, in step **S1-12**, e.g. the S-CSCF **2023** may perform matching the received (e.g. from the P-CSCF **2021**) first network access technology-specific identification information (e.g. WiMAX_ID**1**) against the obtained (e.g. from the UPB **2025**) second network access technology-specific identification information (e.g. WiMAX_ID**2**).

And, in step **S1-12**, e.g. the S-CSCF **2023** may perform authorizing access for the user equipment (e.g. UE **201**) based on a result of matching. The authorization of access may be performed e.g. via the optional I-CSCF **2022** and the P-CSCF **2021** in steps **S1-13** to **S1-15**.

According to further developments of the methods according to the present invention, the network identity-related information and the network identity-related inquiry information may respectively comprise an internet protocol address allocated to the user equipment.

Alternatively, the network identity-related information and the network identity-related inquiry information may respectively comprise an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

Furthermore, the network access technology-related identification information may comprise at least one of a network access identifier, a security parameter index value, and an access, authorization and accounting server identification. In addition, the network identity-related information may comprise a mobile internet protocol home address. And, the network identity-related information may be an internet protocol address used by the user equipment, the internet protocol address being ensured to be constituted by the internet protocol address correspondingly allocated by a network to the user equipment.

FIG. **3** shows respective apparatuses (e.g. ACS **2024**, UPB **2025**, P-CSCF **2021** and S-CSCF **2023**) for user equipment authorization according to the first embodiment of the present invention.

The P-CSCF **2021** may comprise a central processing unit CPU or core functionality CF (referred to as "CPU" hereinafter) **20211**, a memory **20212**, a sender (or means for sending) Tx **20213** and a receiver (or means for receiving) Rx **20214**. The S-CSCF **2023** may comprise a CPU **20231**, a memory **20232**, a sender (or means for sending) Tx **20233**, a receiver (or means for receiving) Rx **20234** and an authorizer (or means for authorizing) **20235**. The ACS **2024** may comprise a CPU **20241**, a memory **20242**, a sender (or means for sending) Tx **20243** and a receiver (or means for receiving) Rx **20244**. And, the UPB **2025** may comprise a CPU **20251**, a memory **20252**, a sender (or means for sending) Tx **20253** and a receiver (or means for receiving) Rx **20254**.

The CPUs **202x1** (wherein x=1, 3, 4, and 5) may respectively be configured to process various data inputs and to control the functions of the memories **202x2**, the senders **202x3** and the receivers **202x4**.

The memories **202x2** may respectively serve e.g. for storing code means for carrying out e.g. the respective method according to the invention, when run on the CPUs **202x1**. It is to be noted that the senders **202x3** and the receivers **202x4** may alternatively be provided as respective integral transceivers (not shown).

As a preparatory measure, a relation of network access technology-specific identification information (e.g. WiMAX_ID**1**) of a user equipment (e.g. UE **201**) or user and network identity-related information (e.g. IP address) of the user equipment may be stored and provided in memory **20242** (means for providing) of the ACS **2024**. In addition, a relation of network access technology-specific identification information (e.g. WiMAX_ID**2**) of a user equipment (e.g. UE **201**) or user and network identity-related information (e.g. IMPI, IMPU) of the user equipment may be stored and provided by the memory **20252** (means for providing) of the UPB **2025**.

Then, e.g. the means for receiving **20214** of the P-CSCF **2021** may be configured to receive a registration request comprising network identity-related inquiry information (e.g. SIP request, IMPI+IMPU) from a user equipment (e.g. UE **2021**).

For example, the CPU **20211** in conjunction with the sender **20213** and the receiver **20214** (means for obtaining) of the P-CSCF **2021** may be configured to obtain network access technology-specific identification information (e.g. WiMAX specific identifier WiMAX_ID**1**, such as NAI) based on the received network identity-related inquiry information (e.g. IP address of the UE **201**).

For example, the means for receiving **20244** e.g. in conjunction with the CPU **20241** of the ACS **2024** may be configured to receive (e.g. from the P-CSCF **2021**) an inquiry comprising network identity-related inquiry information (e.g. IP address of the UE **201**).

Then, e.g. the CPU **20241** in conjunction with the memory **20242** (means for resolving) of the ACS **2024** may be configured to resolve the received network identity-related inquiry information (e.g. IP address of the UE **201**) based on the provided relation (stored e.g. in the memory **20242** of the ACS **2024**).

And, the means for sending **20243** e.g. in conjunction with the CPU **20241** may be configured to send a response comprising the network access technology-specific identification information (WiMAX_ID**1**) according to a result of the resolved network identity-related inquiry information (e.g. IP address **1** of the UE **201**).

Then, e.g. the CPU **20211** of the P-CSCF **2021** in conjunction with the memory **20212** (means for appending) may be configured to append the received network identity-related

inquiry information (e.g. SIP, IMPI+IMPU) with the obtained network access technology-specific identification information (e.g. WiMAX_ID**1**).

And, the means for sending **20213** of the P-CSCF **2021** may be configured to send the appended network identity-related inquiry information (e.g. SIP or IMPI, IMPU+WiMAX_ID**1**).

Furthermore, the means for receiving **20234** of the S-CSCF **2023** may configured to receive (e.g. from the P-CSCF **2021** e.g. via the optional I-CSCF **2022**) a registration request comprising first network access technology-specific identification information (e.g. WiMAX_ID**1**) and network identity-related information (e.g. IMPI, IMPU).

Then, e.g. the CPU **20231** in conjunction with the sender **20233** and the receiver **20234** (means for obtaining) may be configured to obtain (e.g. from the UPB **2025**) second network access technology-specific identification information (e.g. WiMAX specific identifier WiMAX_ID**2**, such as NAI) based on the received network identity-related information (e.g. IMPI, IMPU+WiMAX_ID**2**);

Concerning the obtaining operation, the means for receiving **20254** e.g. in conjunction with the CPU **20251** of the UPB **2025** may be configured to receive the inquiry (e.g. from the S-CSCF **2023**) comprising network identity-related inquiry information (e.g. IMPI, IMPU).

Then, e.g. the CPU **20251** in conjunction with the memory **20252** (means for resolving) of the UPB **2025** may be configured to resolve the received network identity-related inquiry information (e.g. IMPI, IMPU) based on the provided relation (stored e.g. in the memory **20252** of the UPB **2025**).

And, the means for sending **20253** e.g. in conjunction with the CPU **20251** of the UPB **2025** may be configured to send a response comprising the network access technology-specific identification information (e.g. WiMAX_ID**2**) according to a result of the resolved network identity-related inquiry information (e.g. IMPI, IMPU).

Afterwards, e.g. the CPU **20231** (means for matching) of the S-CSCF **2023** may be configured to match received first network access technology-specific identification information (e.g. WiMAX_ID**1**) against the obtained second network access technology-specific identification information (e.g. WiMAX_ID**2**).

And, the means for authorizing **20235** e.g. in conjunction with the CPU **20231** of the S-CSCF **2023** may be configured to authorize access for the user equipment (e.g. UE **201**) based on a result of matching e.g. via the P-CSCF **2021** (and optionally via the I-CSCF **2022**).

According to further developments of the apparatuses according to the present invention, the network identity-related information and the network identity-related inquiry information may respectively comprise an internet protocol address allocated to the user equipment.

Alternatively, the network identity-related information and the network identity-related inquiry information may respectively comprise an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

Furthermore, the network access technology-related identification information may comprise at least one of a network access identifier, a security parameter index value, and an access, authorization and accounting server identification. In addition, the network identity-related information may comprise a mobile internet protocol home address. And, the network identity-related information may be an internet protocol address used by the user equipment, the internet protocol address being ensured to be constituted by the internet protocol address correspondingly allocated by a network to the user equipment.

Furthermore, the UPB **2025** may be a portion of one of a home subscriber server and an access, authorization and accounting server or interfacing with at least one of the home subscriber server and the access, authorization and accounting server.

In addition, the ACS **2024** may be a portion of or interfacing with a mobile internet protocol home agent or an internet protocol router.

In addition, the P-CSCF **2021**, the S-CSCF **2023**, the ACS **2024** and(or the UPB **2025** may implemented as a chipset or module.

Without being restricted to the details following in this section, the first embodiment of the present invention may be summarized as follows:

- a User Profile Binding (UPB) function
  - stores an identifier specific to the WiMAX subscription or session of a MS/User against the IMPU and IMPI being part of the MS/User's IMS subscription, and
  - upon request received from the S-CSCF, returns to the S-CSCF that WiMAX-specific identifier stored against that IMPU and IMPI,
- an Access Control Support (ACS) function in the WiMAX network
  - stores after successful WiMAX network access authorization said WiMAX-specific identifier of the MS against an IP address allocated to the MS and resolves to the IMS system on request an IP address to said identifier,
- a P-CSCF
  - upon reception of a SIP Register request from the MS, asks that Access Control Support function for the WiMAX-specific identifier associated to the IP address as included in the SIP Register request, and
  - appends said WiMAX-specific identifier of the MS to SIP Register requests sent by the MS to its IMS Home Network, and
- a S-CSCF
  - upon reception of the modified SIP Register request from the P-CSCF, sends the IMPU and IMPI contained in that request to the HSS which then returns to the S-CSCF the WiMAX-specific identifier stored against that IMPU and IMPI, and
  - authorizes the MS/user to access the IMS service if and only if the WiMAX-specific identifier as included by the P-CSCF into that SIP Register request coincides with the WiMAX-specific identifier as provided by the HSS.
- where the WiMAX specific identifier can as a not limiting example be an NAI according to IETF RFC **4282**,
- or the WiMAX specific identifier can be a SPI value used for the MN-HA security association for protecting MIP messages,
- or the WiMAX specific identifier can be a AAA session ID as described by [NWG-stage-3],
- or the WiMAX specific identifier can be any combination of two or more of the above identifiers.
- Where the UPB function can be part of a HSS or a AAA server or can interface with a HSS and/or a AAA server,
- the ACS function can be part of, or can interface with a Mobile IP (RFC3344, RFC3775) Home Agent or e.g. a standard IP router.
- Where the IP address can be a Mobile IP HoA (home address).

Where the WiMAX network, for additional security, should ensure that the IP address used by the MS/user device is the IP address assigned to this MS to prevent IP address spoofing.

[Second Embodiment]

FIG. **4** shows respective methods for user equipment authorization according to the second embodiment of the present invention. Reference signs of FIG. **4** identical with those of FIG. **2** denote the same or similar elements. In addition, the network **202** may further comprise an AAA (access, authorization and accounting) server **2022***a*. Again, signalling between elements is indicated in horizontal direction, while time aspects between signalling are reflected in the vertical arrangement of the signalling sequence as well as in the sequence numbers.

Steps S**2**-**0** to S**2**-**11** according to the second embodiment may be performed in the same manner as steps S**1**-**0** to S**1**-**11** according to the first embodiment with the exception that all occurrences of the identifier specific for an access technology (i.e. WiMAX_ID**1**) are replaced with the one of a temporary and a pseudo identifier specific for a subscription or session (i.e. WID_t).

However, in steps S**2**-**12** to S**2**-**14**, e.g. the S-CSCF **2023** may perform obtaining (e.g. from the AAA server **2022***a*), as the first network access technology-specific identification information (e.g. WiMAX_ID**1**), an actual identifier (e.g. WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier (e.g. WID_t) specific e.g. for a worldwide interoperability for microwave access subscription or session.

Afterwards, steps S**2**-**15** to S**2**-**18** according to the second embodiment may be performed in the same manner as steps S**1**-**12** to S**1**-**15** according to the first embodiment.

FIG. **5** shows respective apparatuses (e.g. ACS, UPB, P-CSCF and S-CSCF functions) for user equipment authorization according to the second embodiment of the present invention. Reference signs of FIG. **5** identical with those of FIG. **3** denote the same or similar elements.

In addition, the AAA server **2022***a* comprises a CPU **2022***a***1**, a memory **2022***a***2**, a sender Tx **2022***a***3** and a receiver Rx **2022***a***4**. The CPU **2022***a***1** is configured to process various data inputs and to control the functions of the memory **2022***a***2**, the sender **2022***a***3** and the receiver **2022***a***4**. The memory **2022***a***2** serves for storing a relation between the temporary or pseudo identifier (e.g. WID_t) and the actual identifier (e.g. WiMAX_ID**1**). It is to be noted that the sender **2022***a***3** and the receiver **2022***a***4** may alternatively be provided as an integral transceiver (not shown).

As already described hereinabove in conjunction with FIG. **4**, the means for receiving **20234** of the S-CSCF **2023** may configured to receive the first network access technology-specific identification information comprising one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session (e.g. WID_t), and the means for obtaining **20231**, **20233**, **20234** may be configured to obtain (e.g. from the AAA server **2022***a*), as the first network access technology-specific identification information (e.g. WiMAX_ID**1**), an actual identifier (e.g. WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session.

Without being restricted to the details following in this section, the second embodiment of the present invention may be summarized as follows:

a S-CSCF

upon reception of the modified SIP Register request containing a temporary/pseudo-ID from the P-CSCF, sends the IMPU and IMPI contained in that request to the HSS which then returns to the S-CSCF the WiMAX-specific identifier stored against that IMPU and IMPI,

upon reception of the modified SIP Register request containing a temporary/pseudo-ID from the P-CSCF, resolves the temporary/pseudo-ID by interfacing with an AAA server or a HSS, and

authorizes the MS/user to access the IMS service if and only if the WiMAX-specific identifier as included by the P-CSCF into that SIP Register request coincides with the WiMAX-specific identifier as provided by the HSS.

[Modification of the Second Embodiment]

Alternatively, in the modification of the second embodiment shown in FIGS. **6** and **7**, the comparison of the permanent/actual WiMAX identifier retrieved from the IMS subscription data by the UPB/HSS **2025** and the one resolved by the AAA server **2022***a* can be done by the UPB **2025** instead of the S-CSCF **2023**.

FIG. **6** shows respective methods for user equipment authorization according to a modification of the second embodiment of the present invention. Reference signs of FIG. **6** identical with those of FIG. **4** denote the same or similar elements. Again, signalling between elements is indicated in horizontal direction, while time aspects between signalling are reflected in the vertical arrangement of the signalling sequence as well as in the sequence numbers.

Steps S**3**-**0** to S**3**-**8** according to the modification of the second embodiment may be performed in the same manner as steps S**2**-**0** to S**2**-**8** according to the second embodiment.

In step S**3**-**9** and S**3**-**14**, e.g. the S-CSCF **2023** may perform obtaining (e.g. from the AAA server **2022***a* via the UPB **2025**) based on the received network identity-related information (e.g. IMPI, IMPU) and the received first network access technology-specific identification information (e.g. WID_t), and obtains, as the first network access-technology-specific identification information (e.g. WiMAX_ID**1**), a first actual identifier (e.g. WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access, and obtains, as the second network access-technology-specific identification information (e.g. WiMAX_ID**2**), a second actual identifier (e.g. WiMAX_ID**2**) specific e.g. for worldwide interoperability for microwave access.

In addition, in step S**3**-**9**, e.g. the UPB **2025** may perform receiving the inquiry (e.g. from the S-CSCF **2023**) comprising both network identity-related information (e.g. IMPI, IMPU) and one of a temporary and a pseudo identifier (e.g. WID_t) specific e.g. for a worldwide interoperability for microwave access subscription or session.

In steps S**3**-**11** to S**3**-**13**, e.g. the UPB may perform obtaining, from another network element (e.g. the AAA server **2022***a*), a first actual identifier (WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier (e.g. WID_t) specific for a worldwide interoperability for microwave access subscription or session.

In step S**3**-**10**, e.g. the UPB **2025** may perform resolving similar to step S**2**-**10** to provide a second actual identifier (e.g. WiMAX_ID**2**) specific e.g. for worldwide interoperability for microwave access.

In step S**3**-**14** e.g. the UPB **2025** may perform sending (e.g. to the S-CSCF **2023**), the response comprising both the first obtained actual identifier (e.g. WiMAX_ID**1**) specific e.g. for

worldwide interoperability for microwave access and the resolved second actual identifier (e.g. WiMAX_ID**2**) specific e.g. for worldwide interoperability for microwave access.

Afterwards, steps S**3**-**15** to S**3**-**18** according to the modification of the second embodiment may be performed in the same manner as steps S**2**-**15** to S**2**-**18** according to the second embodiment.

FIG. **7** shows respective apparatuses (e.g. ACS, UPB, P-CSCF and S-CSCF functions) for user equipment authorization according to the modification of the second embodiment of the present invention. Reference signs of FIG. **7** identical with those of FIG. **5** denote the same or similar elements.

As already described in conjunction with FIGS. **5** and **6** hereinabove, the means for obtaining **20231**, **20223**, **20234** of the S-CSCF **2023** may be configured to obtain, based on the received network identity-related information (e.g. IMPI, IMPU) and the received first network access technology-specific identification information (e.g. WID_t), and to obtain (e.g. from the AAA server **2022***a* via the UPB **2025**), as the first network access-technology-specific identification information (e.g. WiMAX_ID**1**), a first actual identifier (e.g. WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access, and to obtain, as the second network access-technology-specific identification information (e.g. WiMAX_ID**2**), a second actual identifier (e.g. WiMAX_ID**2**) specific e.g. for worldwide interoperability for microwave access.

In addition, the means for receiving **20254** of the UPB **2025** may be configured to receive the inquiry comprising both network identity-related information (e.g. IMPI, IMPU) and one of a temporary and a pseudo identifier (e.g. WID_t) specific e.g. for a worldwide interoperability for microwave access subscription or session.

Furthermore, the means for obtaining **20251**, **20253**, **20254** of the UPB **2025** may be configured to obtain, from another network element (e.g. the AAA server **2022***a*), a first actual identifier (e.g. WiMAX_ID**1**) specific for e.g. worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier (e.g. WID_T) specific e.g. for a worldwide interoperability for microwave access subscription or session.

In addition, the means for resolving **20251**, **20252** of the UPB **2025** may configured to resolve the received network identity-related information (e.g. IMPI, IMPU) based on the provided relation (stored in the memory **20252**) to provide a second actual identifier (e.g. WiMAX_ID**2**) specific e.g. for worldwide interoperability for microwave access.

And, the means for sending **20253** of the UPB **2025** may be configured to send (e.g. to the S-CSCF **2023**) the response comprising both the first obtained actual identifier (e.g. WiMAX_ID**1**) specific e.g. for worldwide interoperability for microwave access and the resolved second actual identifier (e.g. WiMAX_ID**2**) specific for worldwide interoperability for microwave access.

Without being restricted to the detail following in this section, the modification of the second embodiment of the present invention may be summarized as follows, wherein only statements deviating from the second embodiment are given:

- a User Profile Binding (UPB) function
  - in case of the identifier specific to the WiMAX subscription or session being a temporary (e.g. session-related) or pseudo identity, is able to resolve this identity to the real identity of the subscription or session of this MS or user. Resolution can be performed by the UPB itself, or by interfacing with a common user data repository and authorization server like an AAA server or a HSS.

In addition, the present invention also relates to a system which may comprise the user equipment **201**, and the above-described P-CSCF **2021**, S-CSCF **2023**, ACS **2024** and UPB **2025**.

[Further Embodiments]

For the purpose of the present invention as described herein above, it should be noted that

- an access technology may be any technology by means of which a user equipment can access an access network (or base station, respectively). Although WiMAX is used hereinabove for descriptive purposes (as an example, the WiMAX-specific identifier may be a NAI), any present or future technology, such as WLAN (Wireless Local Access Network), BlueTooth, Infrared, and the like may be used; although the above technologies are mostly wireless access technologies, e.g. in different radio spectra, access technology in the sense of the present invention may also imply wirebound technologies, e.g. IP based access technologies like cable networks or fixed line.
- a network may be any device, unit or means by which a station entity or other user equipment may connect to and/or utilize services offered by the access network; such services include, among others, data and/or (audio-) visual communication, data download etc.;
- generally, the present invention may be applicable in those network/user equipment environments relying on a data packet based transmission scheme according to which data are transmitted in data packets and which are, for example, based on the Internet Protocol IP. The present invention is, however, not limited thereto, and any other present or future IP or mobile IP (MIP) version, or, more generally, a protocol following similar principles as (M)IPv4/6, is also applicable;
- a user equipment may be any device, unit or means by which a system user may experience services from an access network;
- method steps likely to be implemented as software code portions and being run using a processor at the network element, are software code independent and can be specified using any known or future developed programming language as long as the functionality defined by the method steps is preserved;
- generally, any method step is suitable to be implemented as software or by hardware without changing the idea of the present invention in terms of the functionality implemented;
- method steps and/or devices, units or means likely to be implemented as hardware components at the P-CSCF, S-CSCF, ACS and/or UPB, or any module(s) thereof, are hardware independent and can be implemented using any known or future developed hardware technology or any hybrids of these, such as MOS (Metal Oxide Semiconductor), CMOS (Complementary MOS), BiMOS (Bipolar MOS), BiCMOS (Bipolar CMOS), ECL (Emitter Coupled Logic), TTL (Transistor-Transistor Logic), etc., using for example ASIC (Application Specific IC (Integrated Circuit)) components, FPGA (Field-programmable Gate Arrays) components, CPLD (Complex Programmable Logic Device) components or DSP (Digital Signal Processor) components; in addition, any method steps and/or devices, units or means likely to be implemented as software components may for example

be based on any security architecture capable e.g. of authentication, authorization, keying and/or traffic protection;

devices, units or means (e.g. user equipment and base station) can be implemented as individual devices, units or means, but this does not exclude that they are implemented in a distributed fashion throughout the system, as long as the functionality of the device, unit or means is preserved.

It is to be noted that embodiments described hereinabove show a SIP or IMS Register message as example message where the proposed invention applies. However, the invention applies in the same way to any other SIP or IMS message type.

Also, the invention is not limited to the SIP protocol or the IMS system as specified by 3GPP, 3GPP2, ETSI TISPAN, or other organizations. It can be used identically also for other network or application services that are accessed through a WiMAX network, that have a subscription database similar to the HSS for IMS and a server comparable to the S-CSCF, that is in charge of authorizing the respective control messages sent by the end users/devices. A non-limiting example service would be Instant messaging.

It is also to be noted that the I-CSCF is an optional element in IMS and is not always present (e.g. in a non-roaming case). This, however, does not affect, or impact the present invention. In this case the P-CSCF and S-CSCF would exchange messages directly.

The invention claimed is:

1. A method, comprising:

an apparatus storing a relation of network access technology-specific identification information identifying at least one of a user equipment and a user and network identity-related information of the at least one of the user equipment and the user;

the apparatus receiving an inquiry comprising network identity-related inquiry information;

the apparatus resolving the received network identity-related inquiry information to network access technology-specific identification information based on the provided relation; and

the apparatus sending a response comprising the network access technology-specific identification information according to a result of the resolved network identity-related inquiry information to a first network element to enable the first network element to provide the network access technology-specific identification information to a second network element in order for the second network element to determine whether the at least one of the user equipment and the user is authorized for access depending on whether the network access technology-specific identification information sent by the first network element matches network access technology-specific identification information obtained by the second network element.

2. The method according to claim **1**, wherein the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol address allocated to the user equipment.

3. The method according to claim **1**, wherein the network identity-related information and the network identity-related inquiry information respectively comprise an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

4. A method, comprising:

a first network element receiving a registration request comprising network identity-related inquiry information from at least one of a user equipment and a user;

the first network element obtaining network access technology-specific identification information identifying the at least one of the user equipment and the user based on the received network identity-related inquiry information, the network access technology-specific identification information having been provided by an apparatus as a result of the apparatus having resolved the network access technology-specific identification based on the network identity-related inquiry information;

the first network element appending the received network identity-related inquiry information with the obtained network access technology-specific identification information so as to form appended network identity-related inquiry information; and

the first network element sending the appended network identity-related inquiry information to a second network element in order to determine whether the at least one of the user equipment and the user is authorized for access depending on whether the network access technology-specific identification information sent by the first network element matches network access technology-specific identification information obtained by the second network element.

5. A method, comprising:

a first network element receiving a registration request comprising first network access technology-specific identification information identifying at least one of a user equipment and a user and network identity-related information, the first network access technology-specific identification information having been provided by an apparatus as a result of the apparatus having resolved the first network access technology-specific identification based on network identity-related inquiry information;

the first network element obtaining second network access technology-specific identification information identifying the at least one of the user equipment or and the user based on the received network identity-related inquiry information;

the first network element matching the received first network access technology-specific identification information against the obtained second network access technology-specific identification information; and

the first network element authorizing access for a user equipment based on a result of matching.

6. The method according to claim **5**, wherein the received first network identity-related information comprises an internet protocol multimedia subsystem private identity and an internet protocol multimedia subsystem public identity.

7. The method according to claim **1**, wherein at least one of first and second the network access-technology-specific identification information comprises an identifier specific for worldwide interoperability for microwave access.

8. The method according to claim **1**, wherein the network access-technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session.

9. The method according to claim **5**, wherein, in the receiving, the received first network access technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, the method

further comprising: obtaining, as the first network access technology-specific identification information, an actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session.

10. The method according to claim **5**, wherein, in the receiving, the received first network access technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, wherein the obtaining is based on the received network identity-related information and the received first network access technology-specific identification information, and obtains, as the first network access technology-specific identification information, a first actual identifier specific for worldwide interoperability for microwave access, and obtains, as the second network access-technology-specific identification information, a second actual identifier specific for worldwide interoperability for microwave access.

11. The method according to claim **3**, wherein, in the receiving, the received inquiry comprises both network identity-related information and one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, the method further comprising obtaining, from another network element, a first actual identifier specific for worldwide interoperability for microwave access based on the received one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session, wherein, in the resolving, the received network identity-related information is resolved based on the provided relation to provide a second actual identifier specific for worldwide interoperability for microwave access, and wherein, in the sending, the response comprises both the first obtained actual identifier specific for worldwide interoperability for microwave access and the resolved second actual identifier specific for worldwide interoperability for microwave access.

12. The method according to claim **1**, wherein the network access technology-related identification information comprises at least one of a network access identifier, a security parameter index value, and an access, authorization and accounting server identification.

13. The method according to claim **1**, wherein the network identity-related information comprises a mobile internet protocol home address.

14. The method according to claim **1**, wherein the network identity-related information is a internet protocol address used by the user equipment, the internet protocol address being ensured to be constituted by the internet protocol address correspondingly allocated by a network to the user equipment.

15. An apparatus, comprising: a memory for storing a relation of network access technology-specific identification information identifying a user equipment or user and network identity-related information of the user equipment; a

receiver for receiving an inquiry comprising network identity-related inquiry information;

a processor for resolving the received network identity-related inquiry information to network access technology-specific identification information based on the provided relation; and

a transmitter for sending a response comprising the network access technology-specific identification information according to a result of the resolved network identity-related inquiry information to a first network element to enable the first network element to provide the network access technology-specific identification information to a second network element in order for the second network element to determine whether the at least one of the user equipment and the user is authorized for access depending on whether the network access technology-specific identification information sent by the first network element matches network access technology-specific identification information obtained by the second network element.

16. An apparatus, comprising:

a least one processor; and

at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following:

receiving a registration request comprising network identity-related inquiry information from at least one of a user equipment and a user;

obtaining network access technology-specific identification information identifying at least one of a user equipment and a user based on the received network identity-related inquiry information, the network access technology-specific identification information having been provided by a first network element as a result of the first network element having resolved the network access technology-specific identification based on the network identity-related inquiry information;

appending the received network identity-related inquiry information with the obtained network access technology-specific identification information so as to form appended network identity-related inquiry information; and

sending the appended network identity-related inquiry information to a second network element in order to determine whether the at least one of the user equipment and the user is authorized for access depending on whether the network access technology-specific identification information sent by the apparatus matches network access technology-specific identification information obtained by the second network element.

17. An apparatus, comprising:

a least one processor; and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to perform at least the following:

receiving a registration request comprising first network access technology-specific identification information identifying at least one of a user equipment and a user and network identity-related information the first network access technology-specific identification information having been provided by a first network element as a result of the first network element having resolved the first network access technology-specific identification based on network identity-related inquiry information;

obtaining second network access technology-specific identification information identifying at least one of a user equipment and a user based on the received network identity-related inquiry information;

matching the received first network access technology-specific identification information against the obtained second network access technology-specific identification information; and

authorizing access for a user equipment based on a result of matching.

18. A computer program, embodied on a non-transitory computer readable medium, comprising code for performing methods steps of a method according to claim 1, when run on a computer.

19. A computer program embodied on a non-transitory computer readable medium, product comprising code for performing methods steps of a method according to claim 4, when run on a computer.

20. A computer program. embodied on a non-transitory computer readable medium, comprising code for performing methods steps of a method according to claim 5, when run on a computer.

21. The method according to claim 4, wherein the network access-technology-specific identification information comprises an identifier specific for worldwide interoperability for microwave access.

22. The method according to claim 5, wherein the network access-technology-specific identification information comprises an identifier specific for worldwide interoperability for microwave access.

23. The method according to claim 4, wherein the network access-technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session.

24. The method according to claim 5, wherein the network access-technology-specific identification information comprises one of a temporary and a pseudo identifier specific for a worldwide interoperability for microwave access subscription or session.

25. A method, comprising:

a first network element receiving a registration request comprising network identity-related inquiry information from at least one of a user equipment and a user;

the first network element obtaining first network access technology-specific identification information identifying the at least one of the user equipment and the user based on the received network identity-related inquiry information, the network access technology-specific identification information having been provided by an apparatus as a result of the apparatus having resolved the network access technology-specific identification based on the network identity-related inquiry information;

the first network element modifying the registration request with the obtained first network access technology-specific identification information;

the first network element sending the modified registration request;

a second network element obtaining second network access technology-specific identification information identifying the user equipment or user based on the modified registration request;

the second network element matching the obtained first network access technology-specific identification information against the obtained second network access technology-specific identification information; and

the second network element authorizing access for the user equipment or user based on a result of matching.

26. A method according to claim 25, wherein the network access technology-specific identification information comprises a worldwide interoperability for microwave access (WiMax) identifier.

27. A method according to claim 1, wherein the network access technology of the user equipment is based on worldwide interoperability for microwave access (WiMAX), the network access technology-specific identification information comprises a WiMax identifier, and the network identity-related inquiry information comprises network identity-related information of the user equipment.

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